SINGLE-IMPACT FICHE
LANDSCAPE FEATURES

IMPACT: POLLINATION

Data extracted in May 2022

Note to the reader: This fiche summarises the impact of three landscape features (field margins, flower strips and hedgerows[1]) and landscape features in general (measured together as percentage of natural area) on POLLINATION. It is based on 8 peer-reviewed synthesis research papers[2], including from 29 to 121 individual studies.

1. WEIGHT OF THE EVIDENCE

- CONSISTENCY OF THE IMPACT:
  The effect on pollination differs among landscape features (see **Table 1**):
  - Landscape features in general (measured as percentage of natural area) have a positive effect on pollination (i.e. increase of pollination) and the abundance and richness of some pollinator taxa compared to agricultural lands with lower percentage of natural area, according to 2 synthesis papers reviewed. While 1 of these papers also reports no effect on the abundance and richness of other pollinator taxa.
  - Field margins have a positive effect on pollination compared to cropland or grassland without field margins, according to the 3 synthesis papers reviewed.
  - Flower strips have a positive effect on local pollinator abundance compared to cropland or grassland without flower strips and in the abundance and richness of pollinators in the flower strips themselves, according to 3 synthesis papers review. While flower strips have no effect on pollinators abundance and pollination services in the crops, according to 3 synthesis papers.
  - Hedgerows have no effect on crop pollination compared to cropland without hedgerows, according to 1 synthesis paper reviewed.

The 8 reviewed synthesis papers include data collected in Europe (see **Table 2**).

Table 1. Summary of effects. The numbers between parentheses indicate the number of synthesis papers with a quality score of at least 50%. Details on quality criteria can be found in the next section. Two synthesis papers reported more than one effect for flower strips and some synthesis papers reported effects for more than one landscape feature.

Impact	Intervention	Positive	Negative	No effect	Uncertain
Increase pollination	Landscape features in general	2 (2)	0	1 (1)	0
	Field margins	3 (3)	0	0	0
	Flower strips	3 (3)	0	3 (3)	0

[1] Described in the General Fiche.

[2] Research synthesis papers include a formal meta-analysis or systematic reviews with some quantitative results. Details can be found in the methodology section of the WIKI.

	Hedgerows	0	0	1 (1)	0

QUALITY OF THE SYNTHESIS PAPERS: *The quality score summarises 16 criteria assessing the quality of three main aspects of the synthesis papers: 1) the literature search strategy and studies selection; 2) the statistical analysis; 3) the potential bias. Details on quality criteria can be found in the methodology section of this WIKI.*

2. IMPACTS

The main characteristics and results of the synthesis papers are summarised in **Table 2**. Summaries of the meta-analyses provide fuller information about the results reported in each synthesis paper, in particular about the modulation of effects by factors related to soil, climate and management practices.

Table 2. Main characteristics of the synthesis papers reporting impacts of landscape features on pollination. The references are ordered chronologically with the most recent publication date first.

Reference	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Lowe, EB; Groves, R; Gratton, C 2021	Flower crops	Global	29	Field-edge flower plantings (flower strips)	Unplanted, unmanaged field edges; unplanted, managed field edges (e.g., herbicide or mowing); grass strips; bare ground; and crop fields with no edge	Pollinator abundance and richness in the field-edge flower plantings; Pollinator abundance and richness in the crops	Results suggest that field-edge flower plantings are highly effective at increasing pollinator richness and abundance in field edges and that plantings become more effective as they mature. However, the influence of field-edge plantings on crop pollination is inconsistent.	88%
Albrecht, M; Kleijn, D; Williams, NM; Tschumi, M; Blaauw, BR; Bommarco, R; Campbell, AJ; Dainese, M; Drummond, FA; Entling, MH; Ganser, D 2020	Cropland	North America, Europe, New Zeland	35	1) Flower strips; 2) Hedgerows	No flower strips; 2) No Hedgerows	Crop pollination service	This synthesis reveals inconsistent and highly variable effects of flower strips and hedgerows on crop pollination services.	62%
Zamorano, J; Bartomeus, I; Grez, AA; Garibaldi, LA 2020	Croplands and grasslands	Northern hemisphere	40	Sites with field margin floral enhancement (flower strips)	Sites without field margin floral enhancement	Abundance and richness of pollinators	Overall, the field margin floral enhancements increased the abundance and richness of pollinators at the field edge but had no consistent effect in the interior of the crop fields.	81%
Marja, R; Kleijn, D; Tscharntke, T; Klein, AM;	Croplands and grasslands	Europe	62	Agri-environmental management	No agri-environmental management	Pollinators species richness	This study shows that pollinator species richness benefitted from	81%

Reference	Population	Scale	Num. papers	Intervention	Comparator	Metric	Conclusion	Quality score
Frank, T; Batáry, P 2019				schemes (hedges, field margins and set aside lands) (field margins)	schemes (usually conventional farming)		Agri-environmental management schemes.	
Coutinho, JGD; Garibaldi, LA; Viana, BF 2018	Agroecosystems	Global	43	High landscape complexity as proportion of non-crop area (landscape features in general)	Low landscape complexity (proportion of non-crop area)	Abundance of 1) solitary bees; 2) above-ground nesting bees; 3) below-ground nesting bees; 4) large bees; 5) small bees; Richness of: 6) solitary bees; 7) above-ground nesting bees; 8) small bees	The proportion of non-crop area was positively associated with the abundance and richness of solitary bees and was no related with the other traits.	81%
Duarte, GT; Santos, PM; Cornelissen, TG; Ribeiro, MC; Paglia, AP 2018	Terrestrial landscapes in rural, agricultural, mixed rural–urban or natural habitats regions	Global	121	High landscape complexity as percentage of natural area (landscape features in general)	Low landscape complexity (percentage of natural area)	Pollination (abundance, richness, diversity, and effects of pollinators)	The percentage of natural areas had an effect on pollination (E++ = 0.41). The meta-analyses reinforce the importance of considering landscape structure in assessing ecosystem services for management purposes and decision-making.	81%
Scheper, J; Holzschuh, A; Kuussaari, M; Potts, SG; Rundlf, M; Smith, HG; Kleijn, D 2013	Croplands and grasslands	Europe	71	Sites with agri-environmental measures including 1) sown flower strip; 2) grass-sown or naturally regenerated field margin or set-aside)	Conventionally managed control sites	Abundance and richness of pollinators	This study shows that agri-environmental measures generally enhance local pollinator species richness and abundance in agroecosystems.	69%
Shackelford, G; Steward, PR; Benton, TG; Kunin, WE; Potts, SG; Biesmeijer, JC; Sait, SM 2013	Fields, orchards, and vineyards of food crops	Global	46	High compositional complexity (proximity or diversity of non-crop plants in margins of food crops) (field margins)	Low compositional complexity	Abundance and richness of pollinators	Some pollinators and natural enemies seem to have compatible responses to complexity, and it might be possible to manage agroecosystems for the benefit of both.	81%

3. KNOWLEDGE GAPS

Lowe et al., 2021

Critical gaps in our knowledge of when and how plantings can improve ecosystem service provision and delivery. Longer-duration studies would help to determine if field-edge plantings can influence pollinator population growth and may clarify

	how plantings improve crop pollination, while further research on landscape context and crop type may define when this happens.
Zamorano et al., 2020	Authors detected a bias in publications studying the impact of field margins on biodiversity at the edge of the crop primarily with positive effect sizes and larger standard errors (i.e. low sample size).
Marja et al., 2019	There was a geographical bias in the dataset, as most studies originated from Western or Northern Europe.
Shackelford et al., 2013	The authors identified the interactions between pollinators and natural enemies and their interacting effects on crop productivity as knowledge gaps.